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ABSTRACT

This study was a descriptive curriculum research project covering the development of learning packets on alternative energy. The purpose of the project was to improve instruction in trades and industry exploratory programs by providing alternative energy materials. It was anticipated that the use of a prepared learning package would facilitate the integration of new content on energy into existing vocational programs. The project staff reviewed publications on alternative energy and formulated a reaction packet for a team of teacher-evaluators to use. The teacher-evaluators selected the areas of alternative energy to be developed, rated the proposed general course objectives, and approved a curriculum materials format. The project staff, using this input and in consultation with the State Department of Education energy education staff and the Arkansas Department of Energy, developed five learning packets on alternative energy (see note). These packets were then evaluated by the teacher-evaluators, revised, and 100 copies were made for distribution. On the basis of this study, the following suggestions were made for future action: (1) a series of inservice workshops should be conducted to insure that the materials developed by the project are used by classroom teachers; (2) consideration should be given to the development of additional alternative energy materials, such as materials on the topics of biomass, coal, and geothermal energy; (3) further study should be made into the instructional material needs of the trade and industry exploratory teachers of Arkansas. (KC)

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FINAL REPORT

ALTERNATIVE ENERGY CURRICULUM

FOR

TRADE AND INDUSTRY EXPLORATORY

CONDUCTED BY

UNIVERSITY OF CENTRAL ARKANSAS

CONWAY, ARKANSAS 72032

KENNETH F. JORDAN, PROJECT DIRECTOR

IN COOPERATION WITH

ARKANSAS DEPARTMENT OF EDUCATION

DIVISION OF VOCATIONAL, TECHNICAL, AND ADULT EDUCATION

LITTLE ROCK, ARKANSAS 72201

CE 029 144

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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TABLE OF CONTENTS

		PAGE
I.	INTRODUCTION	1
II.	OBJECTIVES	3
III.	PROCEDURES	6
IV.	RESEARCH FINDINGS	8
V.	EVALUATION	12
VI.	SUMMARY AND RECOMMENDATIONS	18
	SELECTED BIBLIOGRAPHY	20
	APPENDIX A - TEAM MEMBERS OF TEACHER-EVALUATORS	21
	APPENDIX B - MATERIALS SENT TO TEACHER-EVALUATORS	23
	APPENDIX C - LIST OF MATERIALS ANALYZED FOR CONTENT ON ALTERNATIVE ENERGY	44
	APPENDIX D - PLAN FOR IN-SERVICE WORKSHOPS	48
	APPENDIX E - CURRICULUM MATERIALS EVALUATION FORM	51

I. INTRODUCTION

The Problem

Energy demand has exceeded its supply in the United States since the mid 1960's. The country has become energy dependent, relying upon undependable sources for petroleum. In 1977, the United States Bureau of Mines estimated the known global reserves of natural gas and petroleum to last 38 and 31 years, respectively, if the rate of consumption were to remain constant.

The rapidly diminishing reserves and the increasing demand for energy are expected to drive fossil fuel prices up to an all time high. Unavoidably, however, there will come a point when regardless of the price consumers are willing to pay, there will simply be no fossil fuels to be sold. To avoid social and economic crises brought about by severe shortages of conventional energy sources, the production of alternative energies must be developed.

The use of these alternative energies and the overall concept of energy conservation are no longer issues of the future. They have been with us for years and will become an ever more important part of our lives. At present, 1980, the national energy goals for 1985 include:

- Reduction of the annual U.S. energy demand to a growth rate of less than 2 percent.
- Reduction of the level of oil imports to less than six million barrels per day.

- Achievement of a 10 percent reduction of gasoline consumption from the 1977 level.
- Insulation of 90 percent of all American homes and all new buildings.
- An increase in annual coal production to at least four hundred million tons over 1976 production
- Use of solar energy in more than two and one-half million homes.

The Need

All indications are that the energy crisis upon us will remain until positive steps are taken to increase the supply of energy by the development of alternative sources of energy and to reduce the demand by energy conservation measures. Anything that is done along these lines will impinge on vocational education. Now is the time for vocational education to begin to prepare for the emerging technologies and industries of the 1980's. The preparation which is demanded from vocational education lies primarily in the area of curriculum development and in improving existing delivery systems. In addition, all vocational education instructors in the energy technologies and industrial occupations must begin to acquire at least a minimum background of alternative energy sources and energy delivery systems. All must be prepared to also respond in a positive way to the necessity for diminishing the demand for energy.

The National Educational Council on Energy and Power

has made the following recommendations concerning the current status and future needs of in-school energy education:

- Energy education must develop an awareness that conservation is imperative and that it will demand a change in life style.
- There is a need for direction in developing energy education curricula.
- Energy education can be more effective when taught as integrated and interrelated content.
- Acceptance of long-range commitment to energy education will require immediate in-service teacher training programs and upgrading of pre-service programs.
- Adequate funding is crucial especially for curriculum development including the production of classroom materials.

II. OBJECTIVES

Purpose of the Study

The purpose of this project was to improve the instruction in Trade and Industry exploratory programs by integrating alternative energy materials into the curriculum. It was anticipated that the utilization of a prepared learning package would facilitate the integration of new content on energy into existing vocational programs.

Performance Objective

To realize this purpose, the project attempted to achieve the following performance objectives:

Objective One

The project staff would demonstrate ability to research, compile and analyze alternative energy materials regarding the instructional needs of secondary and post-secondary vocational teachers. It was expected that (1) this review would include data on at least five sources of energy, (b) the results of the review would be compiled, analyzed and presented to a panel of advisors for consideration, (c) instructional elements which were acceptable to the panel of advisors would be identified for inclusion in learning packets.

Objective Two

The project staff were to demonstrate ability to design and develop curriculum materials on energy which would provide awareness, technical knowledge and hands-on experience for vocational students. It was expected that (a) a curriculum model would be designed which would be acceptable to teachers and a panel of advisors, (b) the curriculum materials would be developed in consultation with the energy education staff in the Department of Education, (c) learning packets would be developed which would be appropriate for six to nine weeks of instructional time, (d) a sample of teachers would field test and react to the materials.

Objective Three

The project staff would demonstrate ability to design a plan for integrating instructional materials on energy into vocational education programs. It was expected that (a) at least 100 sets of the learning packets would be reproduced for dissemination, (b) a plan of action would be developed for conducting a dissemination/utilization workshop for exploratory teachers, (c) a plan of action would be developed for conducting a follow-up of participating teachers to determine the extent of adoption.

Outcomes

By the conclusion of this project, the research and development activities resulted in the following outcomes:

1. A coordinated effort of teachers, trade and industrial supervisory staff, energy education staff and the project staff in integrating alternative energy materials into the industrial exploratory programs.
2. A six to nine weeks set of learning materials appropriate for exploratory teachers to use in the ninth and tenth grades.
3. Recommendations for using these instructional materials in other secondary and postsecondary vocational programs.
4. One hundred sets of the learning packages.
5. A dissemination/utilization in-service plan for assisting teachers in using the materials.
6. A follow-up plan for determining the extent the materials have been adopted.
7. A final report which includes the need, objectives, activities carried out, project outcomes and evaluation of the project.

III. PROCEDURES

The steps of procedure followed in this project are shown in Diagram I.

Diagram I

Steps of Procedure

Identify Problem

Review of the Literature

Develop Rationale Locate Funding

Identify Curriculum Model

Identify Instructional Elements Select Staff

Develop Learning Units

Field Test Revision

Evaluate

Disseminate to Teachers

A proposal requesting funds was prepared and presented to the Arkansas Research Coordinating Unit, Division of Vocational, Technical, and Adult Education, Arkansas State Department of Education. This proposal was accepted and funded by the aforementioned state agency.

The next step was to identify a team of teachers to serve as evaluators. These evaluators (enumerated in Appendix A) were selected from the vocational exploration teachers in the state of Arkansas, and represented a cross section of technical instruction areas.

The project staff identified ten alternative energy sources for possible inclusion in the developed materials. These areas with a brief description and a proposed curriculum material structure (Appendix B) were submitted to the evaluators. The evaluators selected the five areas of alternative energy they considered most applicable and approved the curriculum material structure.

The project staff then began a detailed literature search to identify the instructional content of the five areas that were selected. Appendix C lists the materials used. The staff of the Arkansas Department of Energy and the Energy Education staff of the Arkansas Department of Education provided interaction to assist in this review.

The content resulting from the literature search was organized according to the curriculum model structure and submitted to the group of teacher evaluators. After their

evaluation, comments regarding the appropriateness of the material allowed the project staff to revise the materials and provide a set of five curriculum guides. These guides were packaged in loose leaf form for teacher use.

A plan for the dissemination and evaluation of the developed materials was prepared and included in the project report as Appendix D and E.

IV. RESEARCH FINDINGS

The Alternative Energy Curriculum Project was a developmental descriptive study and the gathering of data suitable for analysis was a small but important part of the entire project. The results of this data guided the project staff in the development of the alternative energy curriculum packets.

Trades and Industry exploratory teachers who had consented to serve as evaluators for the project were sent a packet containing materials detailing the proposed format of the curriculum materials, ten alternative energy topics, and a list suggesting general curriculum objectives.

Format

The teacher-evaluators were presented a detailed description of the curriculum format designed by the Mid America Vocational Curriculum Consortium. They were requested to indicate approval or disapproval of the

proposed format. All six (100 percent) indicated the MAVCC curriculum was acceptable. Several included favorable comments regarding the material.

Appropriate Topics

The teacher group was also presented ten alternative energy topics and asked to choose those most applicable to Arkansas. Table I shows the frequencies of applicable or non-applicable responses for each suggested topic.

TABLE I

ENERGY TOPICS CONSIDERED APPLICABLE TO ARKANSAS

	Non-applicable	Applicable
Bio-mass	2	4
Coal	2	4
Conservation	0	6
Ethanol	1	5
Fuel Cells	3	3
Geothermal Energy	2	4
Methane	1	5
Nuclear	1	5
Solar	0	6
Wind	0	6

The topics of conservation, solar and wind power were considered to be applicable topics for curriculum development by six or 100 percent of the respondents.

83 percent of the teachers considered ethanol, methane, and nuclear energy to be applicable topics. Bio-mass, coal, and geothermal were considered applicable by 66 percent of the respondents while 50 percent indicated fuel cells were applicable. The teachers were requested to rank the five topics they considered most important in order of priority. Table II shows the topics with frequency of ranks.

TABLE II

RANKING OF ENERGY TOPICS BY TEACHER -EVALUATORS

Energy Topics	Rank 1	2	3	4	5
Bio-mass	-	-	-	-	1
Coal	-	-	1	1	1
Conservation	3	1	1	-	-
Ethanol	-	-	-	4	-
Fuel Cells	-	-	-	-	1
Geothermal	-	-	-	-	1
Methane	-	-	-	-	1
Nuclear	1	-	-	1	1
Solar	2	3	1	-	-
Wind	-	2	3	-	-

Highest Rank - 1
Lowest Rank - 5

Each evaluator ranked only 5 of the ten areas.

Solar received the highest ranking, followed by conservation, wind power, ethanol, and nuclear energy. These topics were selected to be included in the curriculum materials. Topics which received a lower ranking were not included in the curriculum development.

Objectives

Teacher-evaluators were also requested to respond to a list of general course objectives. They were given an opportunity to rate these suggested objectives on a scale of 5 (highly appropriate) to 1 (not appropriate) for students in vocational exploration classes.

The seven general course objectives are that the Alternative Energy Curriculum will give students an opportunity:

1. To work and experiment with energy systems in order to gain an understanding of energy sources, conversion, transmission, storage, and control.
2. To understand the interdependence of society and the availability of energy.
3. To provide an opportunity in which students can gain career information for entry into energy-related occupations.
4. To develop positive attitudes in relation to safety and work habits.
5. To provide an opportunity in which students can gain an insight into the environmental effects of energy.
6. To develop positive attitudes relating to use and conservation of energy.
7. To develop problem-solving and creative techniques in working with energy systems.

The objectives presented as objective #1, Objective #3, and Objective #7 received the highest ratings by the responding teachers. On this basis, these three were selected from the seven as the objectives to be emphasized in the curriculum materials.

These preliminary findings allowed the project staff to:

1. Verify an acceptable curriculum model for structuring the material.
2. Ascertain the most appropriate areas of alternative energy to be included.
3. Select the objectives teachers considered most applicable to vocational exploration programs.

The final materials developed by the project staff were submitted to the teacher-evaluators for a field test and their evaluation. This part of the study was conducted in the subsequent school year from the initial formation of the evaluation group. Therefore there was considerable attrition in the selected group. Three, or 50 percent, of the six original evaluators returned usable reaction forms. All of these reactions were favorable.

V. EVALUATION

The development of the Alternative Energy Curriculum Project was guided by the achievement of the three performance objectives enumerated in the OBJECTIVES section of the report. Table III, Evaluation Summary Chart,

TABLE III

EVALUATION SUMMARY CHART

Performance Objective	Anticipated Achievement		Accomplishments		Date of Completion
	Expected Outcomes	Acceptable Criteria	Level	Percent Achieved	
Objective One					
a. Review will include data on at least five sources of energy	Review of energy materials	Include 5 sources	Included 10 sources	100%	5/30/80
b. Results of the review will be compiled, analyzed and presented to a panel of advisors	Content development process	Compiled, analyzed, presented	Advisors were given packet containing results	100%	5/30/80
c. Instructional elements will be identified for inclusion in learning packets which are acceptable to panel of advisors	Instructional materials identified	Acceptable to advisors	Advisors provided ranking of items to be covered	100%	6/30/80
Objective Two					
a. Curriculum model will be designed which is acceptable to teachers and panel of advisors	Curriculum model approved	Acceptable to teachers	Unanimous acceptance	100%	6/30/80

TABLE III (cont'd)

EVALUATION SUMMARY CHART

Performance Objective	Anticipated Achievement		Accomplishments		Date of Completion
	Expected Outcomes	Acceptable Criteria	Level	Percent Achieved	
b. Curriculum materials will be developed in consultation with the energy education staff of the Department of Education.	Involvement of energy education staff	Consultation	Held personal consultation; sent preliminary copies of learning packets	60%	8/30/80
c. Learning packets will be developed which are appropriate for six to nine weeks of instruction time	Appropriate length of material	Six to nine weeks instructional time	Four units correct length; one unit judged to be too long	90%	9/30/80
d. A sample of teachers will field test and react to materials	Testing and evaluation of preliminary materials	Field test and react	Three of six teachers sent preliminary copies of learning units returned usable reaction forms	50%	12/30/80
Objective Three					
a. At least 100 sets of learning packets will be reproduced for dissemination	Supply of prepared learning units	100 sets	100 sets prepared	100%	2/27/81

14

TABLE III (cont'd)

EVALUATION SUMMARY CHART

Performance Objective	Anticipated Achievement		Accomplishments		Date of Completion
	Expected Outcomes	Acceptable Criteria	Level	Percent Achieved	
b. A plan of action will be developed for conducting a dissemination/utilization workshop for exploratory teachers	In-service training	Plan for workshop	Plan for workshop included in report recommendation	100%	2/27/81
c. A plan of action will be developed for conducting a follow-up of participating teachers to determine the extend of adoption	Evaluation of usage	Plan for conducting follow-up	Evaluation form included in each learning unit	100%	2/27/81

shows the anticipated achievement and the level of accomplishment of each of the objectives.

Objective One specified that the project staff demonstrate ability to research, compile, and analyze alternative energy materials regarding the instructional needs of secondary and postsecondary teachers. The project staff accomplished this objective by preparing a review of ten areas of alternative energy and presenting the review to a panel composed of Trades and Industry exploratory teachers for their acceptance. The specific objectives were judged to have been accomplished at the 100 percent level.

Objective Two required the project staff to demonstrate ability to design and develop curriculum materials which would provide awareness, technical knowledge and hands-on experience for vocational students. Under Objective Two, specific objective (a) pertaining to the selection of a curriculum model was achieved at the 100 percent level since the evaluators were unanimous in their approval. Specific objective (b), consultation with the energy education staff in the Department of Education, was judged to have been 60 percent accomplished by the project staff. The frequency of consultation was considered insufficient to warrant a higher level of accomplishment. Specific objective (c), the length of the learning packets, was judged to have been accomplished at the 90 percent level since one unit was evaluated by the project staff as too

long. However, since this learning unit is divided into three sections, the teacher may adjust the length of instruction by omitting one section if desired. Specific objective (d), field testing, was accomplished at the 50 percent level. Of the original six teacher-evaluators, only three returned usable reaction forms for the preliminary materials. All three reaction forms indicated a favorable response.

Objective Three required the project staff to demonstrate the ability to design a plan for integrating the instructional materials on energy into vocational education programs. Specific objective (a) was accomplished at the 100 percent level since 100 sets of the developed materials were duplicated and prepared for distribution, as specified. Specific objective (b), a plan for a dissemination/utilization workshop, is achieved by the recommendations included in the final section of this report. Specific objective (c), a plan for follow-up of participating teachers, is accomplished at the 100% level by the inclusion of a follow-up questionnaire in each learning packet. It is anticipated that the recipients of the prepared learning packets will return the evaluation questionnaire to the Arkansas Research Coordinating Unit.

VI. SUMMARY AND RECOMMENDATIONS

Summary

This study was a descriptive curriculum research project covering the development of learning packets on alternative energy. The purpose of the project was to improve instruction in Trades and Industry exploratory programs by providing alternative energy materials. It was anticipated that the utilization of a prepared learning package would facilitate the integration of new content on energy into existing vocational programs. A proposal requesting funding was written to the Division of Vocational, Technical and Adult Education, Arkansas State Department of Education. The project was funded, providing salary for a research assistant and a typist, materials duplication, travel and other associated expenses.

The project staff reviewed publications on alternative energy and formulated a reaction packet for a team of teacher-evaluators to use. The teacher-evaluators selected the areas of alternative energy to be developed, rated the proposed general course objectives and approved a curriculum materials format. The project staff, using this input and in consultation with the state Department of Education energy education staff and the Arkansas Department of Energy, developed five learning packets on alternative energy. These packets were then evaluated by the teacher-evaluators, revisions made, and 100 copies

duplicated for distribution.

Recommendations

On the basis of the objectives and findings of this study, the following suggestions are implied for future action:

- In order to insure that materials developed by the project are utilized by classroom teachers, it is recommended that a series of in-service workshops be conducted. The purposes of these training sessions would be to familiarize teachers of Trade and Industry exploratory programs with the prepared materials and assist them in integrating content on alternative energy into their present curriculum. Planning for the in-service workshop is included as Appendix D.

- It is also recommended that consideration be given to the development of additional materials on alternative energy. Although the topics of biomass, coal and geothermal were not selected for development by this project, these alternatives do exist in some quantity in Arkansas. Future curriculum development may well include these or other energy areas. This possibility is addressed in the materials evaluation form which was included in energy curriculum packets. Appendix E is an exhibit of this form.

- It is further suggested that the utilization of the end product of this project, the five curriculum material packets, may justify further study into the exact instructional material needs of the Trade and Industry exploratory teachers of Arkansas.

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APPENDIX A

TEAM MEMBERS OF TEACHER-EVALUATORS

APPENDIX A

TEAM MEMBERS OF TEACHER-EVALUATORS

1. Mr. Laye Bennet
   North Pulaski High School
   Jacksonville, Arkansas

2. Mr. Clive Foy
   Central High School
   Little Rock, Arkansas

3. Mr. Richard Palmer
   Conway Junior High School
   Conway, Arkansas

4. Mr. Harry Phelps
   McClellan High School
   Little Rock, Arkansas

5. Mr. L.B. Roberts
   Metropolitan Vo-Tech Education Center
   Little Rock, Arkansas

6. Mr. Roger Wheetley
   Mabelvale Junior High School
   Mabelvale, Arkansas

APPENDIX B

MATERIALS SENT TO TEACHER-EVALUATORS

1. Letter to Evaluators.
2. Format Description and Response Form.
3. Energy Topic and Response Form.
4. Objectives and Response Form.

APPENDIX B - 1. Letter to Evaluators

University of Central Arkansas

CONWAY, ARKANSAS 72032

Dear Sirs:

I would like to thank you for your consent to help us in the development of the Alternate Energy Curriculum. You will play a very important part in the success of this venture.

The initial phase requires your approval of:

1. An acceptable format;

2. Selection of appropriate topics (5);

3. Grade level oriented general course objectives.

This information is enclosed in this folder. You are asked to pick from the "topics" provided. At the bottom of each page in this section, a place for your remarks has been included. If you have none - please write NONE. The "format" should be read, then accepted or rejected. Please indicate if you have a better idea. The general course objectives should be evaluated in the light of the grade level of the children that this curriculum is to be used with - grades 8 through 10.

You will note that a second portion of this mailing is detached. It is a copy of the reply forms necessary to us. Please indicate your responses again on this section. The first section is to remain for your records. The second section is to be mailed back to us as soon as possible.

Much effort has gone into the design of this response packet. We hope that it will be easy to complete and send back to us.

We gratefully appreciate your help and wish to impress upon you that your reply is very important to us.

Sincerely yours,

Kenneth Jordan
Project Director

Dan Thessing
Research Assistant

KJ:srb

APPENDIX B - RESPONSE FORM

FORMAT

The selection of the format is a matter for your approval. The suggested format for these learning packages will follow the example that was established by the Mid-American Consortium. This format is already being used by the State Department of Education.

Please read the format, then signify at the bottom of this page whether or not you concur. If not, please indicate why and any suggestions for a better format.

_____ I do approve of the proposed format.

_____ I do not approve of the proposed format.

Suggestions: _____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

APPENDIX B - FORMAT DESCRIPTION

FORMAT

All or part of each unit can easily be adapted to any teaching situation. There are generally eight sections to each unit, with each section color-coded according to its purpose within the total unit. The sections are ordered as follows:

1. Unit and Specific Objectives
2. Suggested Activities and Instructional Materials
3. Information Sheet
4. Transparency Masters (when appropriate)
5. Assignment Sheets
6. Answers to Assignment Sheets
7. Test
8. Answers to Test

Unit and Specific Objectives (White)

The unit objective states in inclusive, behavioral terms what action is expected to be done, who will be doing the action, and to what degree that action will be accomplished. It gives an overview of activities and goals which should be met for satisfactory completion of the unit. The unit objective is accompanied by specific objectives which explain in more detail all the activities necessary to fulfill the unit objective.

The unit and specific objectives are to be given to the students. The instructor should explain these objectives fully to the students so that they know exactly what is expected of them. The objectives give direction to student efforts and should serve as a motivational

tool to enhance student interest by showing the relevance of the unit to the students' lives and activities. Whenever possible, the instructor should relate to local situations and personal goals of the students as well.

If necessary or applicable, more specific objectives may be added to suit the needs of instructor and students. Objectives may also be omitted if the instructor chooses to shorten any unit due to limited teaching time or different instructional needs. When objectives are added or omitted, the instructor should remember to adjust the information sheet, assignment sheets and test questions related to those objectives.

Suggested Activities and Instructional Materials (White)

The suggested activities portion is in two parts - those for the instructor and those for the students. This section is intended for the instructor's use only; it need not be distributed to the students.

The suggested activities portion is intended to remind the instructor of all the major tasks that should be done before and while the unit is being presented. Efforts have been made to indicate tasks which may take some time in advance of the actual teaching session, such as writing away for filmstrips and materials or contacting guest speakers. In any case, the activities are merely suggestions and the instructor should feel free to perform or omit any of them in the course of tailoring a unit to the specific teaching situation.

The instructional materials portion lists the contents of the entire unit, item by item. It also includes a listing of additional references, such as books, periodicals, pamphlets, films and other materials which may be used for the instructor's information or to supplement the unit. Prices, showing times, and addresses of companies have been included whenever possible.

Information Sheet (Green)

The information sheet contains all content material which should give students the knowledge needed to accomplish each specific objective. Each main division of the information sheet parallels a specific objective and is numbered to correspond to it. This section of each unit is designed as a permanent reference guide, a kind of "textbook" for the students. The information sheets should be duplicated and distributed to the class.

The instructor should use a variety of teaching strategies for presenting the material on the information sheet. Students may also appreciate an opportunity to familiarize themselves with the information sheet before the material is discussed in class.

Transparency Masters (White)

The transparency masters contained in many of the units offer instructors ready-made visual materials with which to supplement the teaching sessions. Reference is made to a particular transparency in any section of the information sheet to which it applies. Before teaching the unit, the instructor should prepare the transparencies and locate the necessary equipment for showing them in class.

The ideas for the transparencies might serve for bulletin boards and other class displays, if these are appropriate.

Occasionally, handouts are provided in a unit in addition to or instead of transparency masters. In this way, students may be given copies of information on the transparencies as a supplement to the information sheet.

Assignment Sheets (Canary)

Assignments in each unit give the students a chance to practice what they are learning. Some activities are written; others involve field trips, small research projects, actual construction. All are designed to reinforce the learning which occurs through study of the information sheet.

As with all other parts of each unit, the instructor is free to use any or all of the assignments and to adjust them to suit the needs of the students involved. It is helpful to scan these assignment sheets in advance, since occasionally the instructor may need to make some preparations for the assigned activities. The instructor should also be aware that some assignments must be completed outside the classrooms and should distribute the assignment sheets at a point when the students will have sufficient time to do the required tasks.

Answers to Assignment Sheets (Pink)

Answers to assignment sheets are provided to aid both the instructor and the student in the evaluation process. Instructors may choose to allow the students to correct their own assignments where

appropriate or may keep the answer sheets in a permanent instructional manual.

In those cases where some class discussion is recommended concerning an assignment, discussion points are sometimes suggested as an aid to the instructor. As with all other materials in these units, the instructor will adapt this section to fit a particular teaching situation.

Test (Goldenrod)

In order to determine if the specific objectives have been accomplished with the prescribed degree of accuracy, a test is provided for each unit. Each test item is sequenced with a specific objective and an information sheet division.

The test may be administered in whatever manner the instructor feels is appropriate. For example, it may be given at the completion of all unit activities, as a pretest and later postest, or at various stages of the teaching process as each specific objective is accomplished. Whichever method the instructor uses to administer the test, the test score should show both the instructor and the student the degree to which performance objectives have been met. In these units, a score of seventy-five percent or above indicates that the student has mastered the material.

Answers to the Test (Pink)

Answers to the test are provided at the end of each teaching unit. If test results indicate that the student has not mastered all or any part of the unit, it is recommended that the student review the

appropriate material, complete any additional activities assigned by the instructor, and retake the test at a time when both student and instructor judge that the material has been learned to the prescribed degree.

APPENDIX B - RESPONSE FORM

ENERGY TOPICS

Please read the following short summaries of related materials. Keep in mind that you should select five (5) topics that are in your estimate most applicable to Arkansas' needs. Indicate your response by circling NA (non-applicable) or A (applicable) for these energy topics listed below.

Should you have an objection or are in need of more information, please contact us right away.

1.	BIO-MASS	NA	A
2.	COAL	NA	A
3.	CONSERVATION	NA	A
4.	ETHANOL	NA	A
5.	FUEL CELLS	NA	A
6.	GEOTHERMAL	NA	A
7.	METHANE	NA	A
8.	NUCLEAR	NA	A
9.	SOLAR	NA	A
10.	WIND	NA	A

Please indicate five (5) selections in the order of priority:

1. _____ (highest)
2. _____ (next)
3. _____ (next)
4. _____ (next)
5. _____ (next)

APPENDIX B - ENERGY TOPICS DESCRIPTION

ENERGY TOPICS

Bio-mass

An ideal solar collector has already been designed. Requiring virtually no maintenance, it is economical and non-polluting; it uses an established technology and it stores energy. It is called a plant.

Indeed, organic matter from plants and animals, or bio-mass, constitutes near-term and accessible form of solar energy. Photosynthesis, occuring naturally worldwide, stores more than ten times as much energy annually in plant form than is consumed by all mankind. But very little of this energy is tapped, particularly in the developing countries.

There are several different methods for bioconversion, which is the term for the transformation of bio-mass into usable energy. One is the simple direct burning of solid wood or other plants. The second is the conversion of bio-mass into a liquid. Brazil, for instance, has a goal of replacing 20 percent of its gasoline with alcohol derived from plant matter, primarily sugar cane, by the year 1981. A third method is a biological process in which bacteria break down organic waste into methane gas. Considerable research is now going on to develop new sources of bio-mass, such as quick growing plants, that would provide greater supplies of fuel base plants.

Remarks or Criticism:_____

_____

_____

_____

Coal

Coal is a fossil fuel formed from the remains of vegetation. Half a billion years ago, the earth was warmer and wetter than it is now. Fern trees, huge mosses, and other tropical plants grew profusely in the earth's swampy surface. They died and fell into the shallow water, building layer upon layer. Cut off from the oxygen by the water, much of the plant matter remained undecayed. As time passed this undecayed organic matter built up into the spongy substance we call peat. Dirt and sand washed down from the mountains and gradually buried the peat deeper and deeper. As the pressure compacted it and the heat increased much of the gaseous part, the hydrogen and oxygen, were driven off and almost pure carbon was left behind- the hard, shiny black mineral we call coal.

The fact that Arkansas will be a leader in the production of coal in the near future is a very good reason for the inclusion of the use of this form of energy in the energy curriculum.

Remarks or Criticism: _____

Conservation

Among the unconventional sources of energy, conservation presents itself as the most immediate opportunity. It should be regarded as a largely untapped source of energy. Indeed, conservation - not coal or nuclear energy - is the major alternative to imported oil. It could perhaps "supply" up to 40 percent of America's current energy usage, although we do not predict that it will. Moreover, the evidence suggests that there is much greater flexibility between energy use and economic growth than is generally assumed, and that a conservation strategy could actually spur growth. Conservation does not require technological breakthrough. But it has been difficult to tap, because a consistent set of signals - price, incentives, and regulations - is not in place. Moreover, the decentralized character of energy decisions to conserve, unlike decisions to produce energy, have to be made by millions and millions of often poorly informed people.

Remarks or Criticism: _____

Ethanol (Alcohol Fuel)

Shortages and high cost of petro fuels accompanied by recent international developments have created new interest in alcohol for motor fuel use. Alcohol has been used as a motor fuel in the past and is currently available in the 9:1 gasoline ethanol blend known as gasohol.

Ethyl alcohol is also known as grain alcohol. It is the product in beverage alcohol. It is also the preferred alcohol for motor fuel use, because it vaporizes easily, contains the most energy per gallon, and is the least corrosive of the three alcohols (ethyl, methyl and isopropyl). Depending on the distillation process, it can also be non-toxic. Production is by the fermentation of sugars which can come from sugar crops such as cane or beets or from the conversion of starches in grain crops such as corn or grain sorghum (milo). New technology has resulted in cellulose-to-sugar process that makes fermentable sugars available from waste products.

Remarks or Criticism: _____

Fuel Cells

A fuel cell is an electric device that converts chemical energy into electrical energy by consuming a fuel and an oxidant that are continuously supplied to the cell. The fuel and oxidant, which enter the cell at the electrodes, function as the chemically active components of the electrodes. The fuel cell produces direct current electricity and generally has a voltage of one to two volts. Fuel cells can be connected in a series to provide a battery having a higher voltage than a single cell.

Fuel cells convert chemical energy directly to electricity, with conversion efficiencies ranging from 65% to 85%. In contrast, steam turbine, diesel, and other engine-driven electrical generating systems have lower overall efficiencies. For large power applications, however, fuel cells are too costly.

Remarks or Criticism: _____

Geothermal Energy

The earth's interior is molten rock, or magma as the geologists call it. There is a tremendous amount of energy in the earth. Although heat energy is an active or kinetic form of energy, the heat of the earth's interior is effectively stored and insulated by the solid, thin crust on which we live.

The geological conditions which produce geothermal energy restrict this energy source to a few geographic areas. Where available, it is inexpensive, clean and has few adverse environmental effects. It is available to us in those regions where the magma is close to the surface and the energy can leak out from the core through the cracks in the crust. Volcanoes, geysers, and hot springs are visible evidence of geothermal reservoirs, but more sophisticated techniques will soon allow us to find others not evident on the earth's surface.

The temperature of the earth just below the frost line lends itself to current usage through the use of wells for home heating and cooling. The methods and machinery is now available for the adaptation of a home heating and cooling unit to the use of the "exotic" techniques.

Remarks or Criticism: _____

_____

_____

_____

_____

_____

_____

Methane

Methane is a gas made from municipal wastes through the process of anaerobic digestion. The gas is a by-product of the bacterial action of decay that produces gas that can be burned. Methane as a fuel substitute for internal combustion engines has been in use for quite some time. Necessary carburetion adjustment information is readily available and methane is a renewable resource. Maine has a large ongoing project which would be valuable to an energy teaching project in New England. The logical set-up for a practical working demonstration unit is a small gasoline engine with a dual fueling system and a selector switch for gasoline or methane.

Remarks or Criticism: _____

Solar

The sun is our major source of energy. Its energy is used in many ways. The sun gives energy as light, it is absorbed and used by plants to manufacture food, and it gives heat, which we have just started to learn how to use. The energy provided by the sun is renewable and clean.

The most practical use of solar energy today is in direct conversion into heat. One method widely used consists of a flat surface to absorb the sun's heat. The heat is transferred to air or to liquid, usually water, which is then circulated to a container where the heat is stored or used.

Within the next few years we may see the sun's energy used for heating and cooling buildings. Nearly one fourth of the energy used in the United States is used for heating and cooling, and supplying hot water for buildings. Solar energy could greatly help in our effort to use less of our non-renewable fuels.

Remarks or Criticism:_____

Wind

Wind energy research receives markedly less support than other systems for producing electricity from the sun's energy, even though wind technology is far more advanced because of its long history of development.

Wind machines have been technically proven. They represent a kind of electromechanical technology that American industry can successfully mass-produce. Many types are commercially available and in selected locations they are already competitive. Without a doubt, wind energy is the cheapest form of solar electricity available today.

Wind power research has been badly underfunded, and the crucial questions of the best design philosophy and manufacturing philosophy have been woefully neglected.

Wind power does not need a breakthough to put it in the right economic ball park to be competitive. Small systems may already be attractive, and are certainly easy to implement. Wind power ranks near the top in projections of the contributions various solar energy technologies can make after the turn of the century.

Remarks or Criticism: _____

APPENDIX B - OBJECTIVES AND RESPONSE FORM

General Project Objectives

Based upon the needs of the nation and the State of Arkansas, the University of Central Arkansas proposes that a Vocational Exploration Energy Curriculum Project be established to offer an organized response to the challenge of alternative energies.

The purpose of this project is to improve the instruction in Trade and Industrial Exploratory programs by integrating alternative energy materials into the curriculum. It is anticipated that the utilization of a prepared learning package will facilitate the integration of new content on energy into existing vocational programs.

On the following page you are asked to rate course objectives on a scale of 5 (highest), 3 (moderate), and 1 (low) applicability to the alternative energy curriculum.

General Course Objectives

Rate 5-3-1

1. To work and experiment with energy systems in order to gain an understanding of energy sources, conversion, transmission, storage, and control. ____

2. To understand the interdependence of society and the availability of energy. ____

3. To provide an opportunity in which students can gain career information for entry into energy-related occupations. ____

4. To develop positive attitudes in relation to safety and work habits. ____

5. To provide an opportunity in which students can gain an insight into the environmental effects of energy. ____

6. To develop positive attitudes relating to use and conservation of energy. ____

7. To develop problem-solving and creative techniques in working with energy systems. ____

Name_____ Date_____

APPENDIX C

LIST OF MATERIALS ANALYZED FOR CONTENT ON ALTERNATIVE ENERGY

APPENDIX C-LIST OF MATERIALS ANALYZED FOR CONTENT ON ALTERNATIVE ENERGY

Solar

Hand, A.J. and Carl J. De Groote. Home Energy How-To. Harper and Row, New York, 1977..

McVeigh, J.C. Sun Power, An Introduction to the Applications of Solar Energy. Pergamon Press, New York, 1977..

Metz, William D. and Allen L. Hammond. Solar Energy in America. American Association for the Advancement of Science, Washington D.C., 1978..

Posthuma, Fredrick E., Ed. Energy and Education: Teaching Alternatives. National Education Association Publication, Washington D.C., 1978..

Conservation

Auer, P.L., P.B. Box, V.W. Roberts, and W.C. Gough. World Energy Resources 1985-2020, Renewable Energy Resources - The Full Reports to the Conservation Commission of the World Energy Conference. IPC Science and Technology Press, 1978.

Baron, Stephen L. Manual of Energy Saving in Existing Buildings and Plants. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1978.

Halacy, D.S. Earth, Water, Wind, and Sun - Our Energy Alternatives. Harper & Row Publishing, New York, 1977.

Hand, A.J. and Carl J. De Groote. Home Energy How-To. Harper and Row, New York, 1977.

Hart, Kimball G. How to Cut Your Energy Costs - A Guide to Major Savings at Home and on the Road. U.S. News & World Report Books, Washington, D.C., 1978.

Holtzclaw, Frank and Harry Tschumi. Energy Saving Homes - the Arkansas Story. Owen-Corning's Series published by the Owens-Corning Fiberglass Corp., Fiberglass Tower, Toledo, Ohio 43659, 1977, Pub. No. 4-BL-6958-D.

Meador, Roy, Future Energy Alternatives - Long Range Prospects for America and the World. Ann Arbor Science Publishers, Inc., 1979.

Total Environmental Action, Inc., Passive Solar Design Handbook, prepared for the U.S. Department of Energy, Assistant Secretary for Conservation and Solar Energy, Office of Solar Applications for Buildings, Washington, D.C. 20585, Volume I of two volumes, March 1980 DOE/CS-0127/1 US-59.

Conservation (cont'd)

Wade, Alex and Neal Ewenstein. 30 Energy Efficient Houses You Can Build. Emass, Pa., Rodale Press, 1977.

Waschek, Brownlee and Carmen Waschek. Inflation Fighter's Big Book - Beat the High Cost of Operating Your Home. Reston Publishing Co., Inc., Reston, Va., 1979.

Alcohol Fuels

Crombia, Lance. Making Alcohol Fuel, Recipe and Procedure. Rulan Publishing, Post Office Box 3585, Minneapolis, Minnesota, 1979.

Drinkwater, Al. Arkansas Energy Future - Alcohol. Arkansas Department of Energy, Little Rock, Arkansas, 1979.

Emert, George H., Gary Huitink and John Langston, Production and Use of Ethanol. Arkansas Cooperative Extension Service Bulletin No. MP 180-20M-3-80, 1980.

New York Times, "Is Alcohol the Fuel of the Future?", You and Your World Publications, Vol. 12, No. 1, September 12, 1980.

Wortham, Jim. How to Make Your Car Drink Alcohol. Love Street Books, P.O. Box 58163, Louisville, Kentucky, 1979.

Wind Power

Baker, Richard H. and William J. Jones, "Wind Energy", Energy and Power Journal, January 1978, pp. 24-27.

Bereny, Justin A. "Wind Energy Conversion", Survey of the Emerging Solar Energy Industry, Solar Information Service, San Mateo, California, 1977.

Metz, William D. and Allen L. Hammond. Solar Energy in America. American Association for the Advancement of Science, Washington, D.C., 1978.

McVeigh, J.C. Sun Power, An Introduction to the Applications of Solar Energy. Pergamon Press, New York, 1977.

Savino, Joseph M. Wind Energy Conversion Systems. National Science Foundation, Washington, D.C., 1973.

Nuclear Energy

Deutsch, R.W. Nuclear Power. General Physics Corporation, Columbia, Md., 3rd Ed., 1979.

Edison Electric Institute. Nuclear Power, Answers to Your Questions. USA, 1978, Publication No. EEI-78-24.

International Atomic Energy Agency. Radiation a Fact of Life. A-1400 Vienna, Austria, Sept. 1979.

Lapp, Ralph and George Russ. Radiation Risks for Nuclear Workers. Public Affairs and International Information Program, Atomic Industrial Forum, Inc., Washington D.C., November 1979.

Weaver, Kenneth F., The Promise and Peril of Nuclear Energy. National Geographic Magazine, Washington D.C., April 1979.

APPENDIX D

PLAN FOR IN-SERVICE WORKSHOPS

APPENDIX D - PLAN FOR IN-SERVICE WORKSHOPS

Ultimate success or failure in the implementation of educational innovations most often depends upon the acceptance by the adopting unit or teacher. In many cases, innovations or curricular changes are developed externally and then transmitted to the school setting where it is assumed the change will be accepted. As a result many worthwhile innovations fail due to lack of understanding on the part of the teacher. The participation of the teacher in in-service training designed to incorporate the desired educational change is a vital ingredient in the implementation process. However, as pointed out by Welch and Yung[1] in a study of Pennsylvania teachers, in-service training must be offered at the convenience of the teacher in order to attract the widest possible attendance. In their study Welch and Yung found that although nine out of every ten teachers were interested in in-service training, four of every ten teachers preferred educational activities at their employing institution and seven out of every ten teachers would travel no more than forty miles to attend any in-service activity. Pennsylvania teachers also wanted in-service work to be of short duration with expenses reimbursed.

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[1] Frederick G. Welch and Kirby Yung, "Inservice Training Needs of Postsecondary Occupational Teachers in Pennsylvania", Journal of Industrial Teacher Education, 1980, Vol. 17, No. 2, pp. 41-45.

In so much as Arkansas teachers are similar to Pennsylvania teachers, the findings of this study should influence plans for in-service training in alternative energy curriculum usage. Therefore, it is suggested that in-service training sessions conform to the following criteria:

1. Training sessions should be of short duration, one day maximum.
2. These implementation courses should be offered at a number of locations over the state to insure that teachers are conveniently close.
3. Such in-service activities should be made available at no cost to the participating teachers.

APPENDIX E

CURRICULUM MATERIALS EVALUATION FORM

Dear Teacher:

The evaluation of the completed materials is a critical step in the curriculum development process. It is required that all recipients of the materials prepared by the Alternative Energy Curriculum Project furnish such an evaluation. After you have had time to review this learning packet, complete this questionnaire and return it to the Arkansas Research Coordinating Unit.

This evaluation is for: (Check (✓) one)

( ) Alcohol Fuels ( ) Nuclear Energy ( ) Wind Power

( ) Conservation ( ) Solar Energy

Evaluate each section of the learning packet by placing a check (✓) in the Favorable or Unfavorable column. If the evaluation is Unfavorable, please state the reason in the space beside the section name.

Favorable	Unfavorable		
( )	( )	Information Section	_____
( )	( )	Instructional Materials	_____
( )	( )	Student Study/Assignment Sheets	_____
( )	( )	Tests	_____

Evaluate the following characteristics of the learning packets by placing a check (✓) in the appropriate response.

Readability: ( ) Too High ( ) Too Low ( ) Right Grade Level

Material Length: ( ) Too Long ( ) Too Short ( ) Correct Length

Technical Level: ( ) Too Technical ( ) Too General ( ) Right Technical Level

---

Do you plan to use this material in your classes? Check (✓) Will or Will Not. If Will, supply requested information. If Will Not, state reasons.

( ) Will

Name of Class _____

Grade Level of Class _____

School Name _____

( ) Will Not

Reasons _____

If additional Alternative Energy Curriculum materials would be of use in your classes, check (✓) those energy topics which should be developed.

( ) Bio-Mass ( ) Fuel Cells ( ) Methane ( ) Coal ( ) Geothermal

( ) Other _____

Thank you for your evaluation. Fold this questionnaire so the return address is on the outside. Seal with a small piece of tape. Place a first class stamp in the upper right hand corner and mail.